*Fig.* 139. Pollen granule of Epilobium angustifolium.
140, 141. Pollen granule of Godetia rubicunda; 141. exhibits the extine separated from the other membranes.
142. Pollen granule of Fuchsia coccinea.
143. —— ——— of Fuchsia Devonia.
144. —— ——— of Fuchsia fulgens.
145. —— ——— of Fuchsia thymifolia.
146, 147, 148. Pollen granule of Heracleum Spondilium; 146, its dry or primary form; 147, its moist or secondary condition; and 148, end views of it in the same state.
149. Pollen granule of Didiscus cæruleus.
150. —— ——— of Magnolia grandiflora.
151, 152. Pollen granule of Nymphæa alba; 151, in its dry, and 152, in its moist condition.
153. Pollen granule of Fumaria officinalis.
154, 155. Pollen granule of Eschscholtzia californica; in the second figure the pollen tubes are just emerging from the extine.
156, 157. Pollen granule of Ranunculus acris; 156. represents a side view of it in its primary form; 157, an end ditto in the same state; and 158, in its secondary form, with a pollen tube issuing through each fissure.

[The above paper was consigned to our care in the autumn of last year, the delay in its appearance having been occasioned by the number of illustrations.—Ed.]

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## PROCEEDINGS OF LEARNED SOCIETIES.

### GEOLOGICAL SOCIETY.

June 30, 1841.—"A description of a portion of the skeleton of the Cetiosaurus, a gigantic extinct Saurian Reptile occurring in the Oolitic formations of different portions of England," by Professor Owen, F.R.S., F.G.S.

The remains described in this memoir consist of vertebræ and bones of the extremities obtained by Mr. Kingdon from the oolite quarries of Chipping Norton, in Oxfordshire; of vertebræ and other bones from the oolite of Blisworth, near Northampton, transmitted to the author by Miss Baker; and of other remains from the oolite of Staple Hill, Wotton, three miles north-west of Woodstock; from the oolite near Buckingham; the Portland stone at Garsington and Thame, in the collection of Dr. Buckland: Mr. Owen has likewise examined a vertebra and some bones of the extremities of the same saurian from the Yorkshire oolite, and preserved in the Scarborough Museum.

*Caudal Vertebræ.*—A caudal vertebra from near Buckingham, which presented the anchylosed neural arch entire, but with the transverse, oblique and spinous processes broken off, equalled in dimensions a middle caudal vertebra of a full-sized whale, the antero-posterior diameter being five inches, the transverse eight inches six lines, and the vertical seven inches. The sides and under part of the centrum are described as very concave; and the shape of the articular extremities as nearly circular, with a greater concavity in the anterior one than in the posterior. The posterior hæmapophysial articular surfaces slope downwards and forwards in the form of semicircular facets for nearly two inches upon the under surfaces. The neurapophyses commence close to the anterior surface of the centrum, their antero-posterior extent being three and a half inches, and they meet at a rather acute angle above the spinal canal. The vertical diameter of the spinal canal was one inch nine lines, the transverse two inches, and the breadth of the base of the neural arch, from the outside of the neurapophyses, five inches three lines. The transverse process is developed from the centrum just below the neurapophysial suture. In all the caudal vertebræ of the Cetiosaurus the posterior half of the centrum is left uncovered by the neural arch.

The substance of another fractured vertebra, showing the upper third of the centrum, presented an uniform coarse spongy texture; whilst in a third specimen, which exhibited also a similar texture, the layers affected a direction parallel with the articular extremities for about half an inch from their surfaces, and inclined to the longitudinal course in the intermediate space. This structure, Mr. Owen states, proves that the vertebra cannot belong to the *Poikilopleuron Bucklandi.*

A caudal vertebra also from Buckingham, and assigned by Professor Owen to the middle part of the tail, on account of the development of short, narrow transverse processes just below the neurapophysial sutures, exhibited a centrum of a subtrihedral form, with one angle inferiorly and the other two at the origin of the transverse processes, but all three largely rounded off. The marginal circumference of the centrum was convex, and separated from the lateral or free surface by a rough, irregular, elevated ridge, the inferior part of which encroached upon the under surface of the vertebra in the form of two semicircular facets, both anteriorly and posteriorly. The free surface of the vertebral centre is marked by the coarse lines of the bony fibrous structure, decussating like an irregular net-work. The spinal canal of this specimen did not sink into the body of the vertebra. The size of this vertebra, and the proportions and position of neurapophyses and hæmapophysial articulations, might suggest a relationship of the animal to which it belonged with the Cetacea; but it differs, Mr. Owen says, in the concavity of the terminal articulations, which show no sign of separation as laminar epiphyses, and more particularly in the place of the origin of the transverse process being close to the neurapophysis instead of proceeding from the middle of the side of the centrum. In these deviations from the Cetacea, the Cetiosaurus approaches, the author states, the saurian order.

Mr. Owen then describes, with his wonted minuteness and perfect acquaintance with the subject, other caudal vertebræ found at Blisworth, but it is not possible to abridge the details.

Among the remains discovered near Chipping Norton are eleven caudal vertebræ without transverse processes, and therefore assigned by the author to the terminal half of the tail. They progressively diminished in transverse diameter from five inches to two inches, but without losing in equal ratio their length, which continues the same, or five and a half inches in the vertebra which has only three inches and three lines of breadth, five inches in that which is two inches and nine lines broad, and four inches in that which has a breadth of two inches. These eleven vertebræ do not constitute, Mr. Owen shows, a regular sequence, but detached links of the termination of the spinal column. In all the existing genera of Cetacea the posterior caudal vertebræ become shorter in proportion to their thickness, and the terminal ones are depressed. The slender elongated form of the corresponding vertebræ in the Cetiosaurus, is, Mr. Owen shows, a striking crocodilian character; and he adds, it is important to observe that not any of the series of caudal vertebræ described in this paper exhibit the vertical canals or perforations of the side of the centrum or base of the transverse process which so peculiarly characterizes most of the cetacean caudal vertebræ.

In his comparison between the vertebræ of the Cetiosaurus and the Poikilopleuron, Professor Owen states that the caudal vertebræ of the former resemble those of the latter and most other reptiles from strata below the chalk in the articular surfaces being slightly concave; and the vertebræ of the Poikilopleuron, especially in the elongated and rounded form of the body; in its median compression, and in the articulation of the hæmapophyses to the inferior part of the vertebral interspaces, though they are larger; on the contrary, the Cetiosaurus vertebræ differ in their proportions, in their structure, as in the absence of the remarkable medullary cavity in the middle part of the centrum of the Poikilopleuron; in the shortness of the neurapophyses as compared with the centrum; and in other minor points, which are fully detailed by Professor Owen.

The author then proceeds to institute further comparisons between the vertebræ of the Cetiosaurus and other reptilia: thus he shows that they differ from the vertebræ of the Crocodilians in retaining the cylindrical form of the body to the end of the tail, instead of being compressed and four-sided; that there is no trace of the vertical median division which the bodies of the caudal vertebræ present in Iguanæ, Anolides and other Lacertians; that they are not only larger than in the Megalosaurus, but relatively longer; that they differ from the anterior caudal vertebræ of the Iguanodon, which are nearly as large, in the absence of the well-marked concavity below the transverse processes, in the form of the centrum not being so quadrilateral, and especially in the transverse breadth of the inferior surface being less; and from the posterior caudal vertebræ of the Iguanodon, which slightly increases in length, in being less compressed and the centrum not having a triangular form; the slender terminal caudal vertebræ of the Iguanodon are also hexagonal, and not cylindrical as in the Cetiosaurus.

As there is no known extinct saurian which can so nearly compete in size with the Cetiosaurus as the Iguanodon, it is fortunate, Prof. Owen observes, that the distinguishing characters are so well marked and easily recognizable.

*Dorsal vertebra.*—The only portion of a dorsal vertebra described in the memoir is the extremity of a spinous process, the posterior surface of which is rough and flattened, 4 inches across, at about the same distance below the end of the spine; the sides are traversed to a certain extent by a longitudinal ridge, anterior to which they are concave and smooth, but their anterior margin is again flattened and rough, though it is not so broad as the posterior.

In referring all the vertebræ described in this paper to the same species of saurian, Prof. Owen admits that they present a somewhat greater variety of form and proportion in different regions of the tail than is observable in that part of the vertebral column in the smaller and recent species of Crocodile or Lizard; not only becoming larger in proportion to their thickness, but increasing slightly in length for a short distance as they recede from the sacrum. They appear likewise to exchange from a cylindrical to a subtriedral form of the body, but to resume the cylindrical shape in the terminal half of the tail. These modifications, he says, are possible, as in the *Plesiosaurus brachydeirus* still greater discrepancies in the proportions of the vertebræ prevail; and they are inferior in degree to any of the modifications which distinguish the vertebræ of known genera of saurians from those under consideration, in pointing at their distinguishing features from the hitherto known sauria; and in thus treating of them collectively, the inference that they belong to the same gigantic species is, the author observes, almost irresistible, that they belong to a new and distinct genus, which, on account of the vertebræ approximating in size and structure to the vertebræ of the whale, he has termed Cetiosaurus.

In the cuttings for the London and Birmingham Railway near Blisworth, there were found, scattered over an area of 12 feet by 8 feet, the following remains:—1. A bone resembling the episternal of an Ichthyosaurus, the length or antero-posterior extent of the preserved portion of the median plate being 1½ foot, and the breadth of the posterior fractured end 5 inches, from which it gradually expands to the root of the side branches, where its breadth is 1 foot. From its obtuse termination to the end of the longest branch is 2½ feet, and from this end to that of the opposite branch 4½ feet. 2. The remains of a coracoid and scapula apparatus of equally gigantic proportions. 3. A fragment, considered to be the shaft of a humerus, 1 foot 9 inches in length, 6 inches in diameter across the middle and 8 inches across the widest end. 4. A portion of the opposite humerus. 5. Another fragment, believed to be part of a radius or ulna, about a yard in length, 6 inches across the proximal end, and 5 inches across the middle of the shaft. 6. A slightly curved portion of a rib, a yard long and from 1½ to 2 inches thick. 7. Five caudal vertebræ agreeing in dimensions with the vertebræ of Chipping Norton.

Numerous fragments of long bones without a trace of a medullary cavity have been found at Chipping Norton, and correspond in magnitude with the vertebræ. The articular surfaces which are preserved are covered with large tubercles for the attachment of thick cartilages. The best-preserved fragments are considered to belong to metacarpal or metatarsal and phalangeal bones, and are therefore, Prof. Owen says, decisive evidence against the cetacean nature of the animal; but he adds, they possess characters by which they may be distinguished from the corresponding bones of known extinct gigantic saurians. One of these bones, believed to be a metacarpal or a metatarsal, is double the bulk of the largest analogous bone of a full-grown elephant, though the metacarpals or metatarsals are much smaller in proportion in Saurians than in Pachyderms. The bone is 7 inches in length, 9 in circumference in its middle, 5 in the antero-posterior diameter of its proximal end, and 4 inches 8 lines in the transverse diameter of the distal end. A proximal phalanx is shown to be remarkable for its short and broad proportions, which are more massive than those of the phalanges of existing Crocodilians or of the Poikilopleuron.

An ungueal phalanx, also found at Chipping Norton, was 6 inches in length, 2½ in breadth, and upwards of 3 in depth. It was slightly curved, obliquely compressed, obtusely terminated with a shallow, concave, trochlear articular surface, divided by a vertical convexity; it was marked on each side by a smooth curved groove, 3 inches in length, with the concavity downwards, and the lower edge projecting beyond the upper at the posterior part of the groove; but it is shown to be by no means produced in so large and thick a ridge as that which characterizes each side of the more depressed and broader phalanx of the Iguanodon. From the ungueal phalanges of that Saurian it differs in being much less compressed from side to side and less curved downwards. It vastly surpasses in size any of the ungueal phalanges of the Poikilopleuron. A smaller ungueal phalanx, resembling in general shape the above, was found at Chipping Norton; and portions of metacarpal or metatarsal bones, agreeing in form and size with the fragments obtained at Chipping Norton, have been discovered at Buckingham: also a fragment 8 inches long, which Prof. Owen considers to have belonged to a radius, a fibula, or a long distal phalanx.

With reference to a comparison of the remains of the Cetiosaurus with those of the Polyptychodon, the bones of the extremities present in both cases the cancellous structure throughout the central part, which indicates aquatic rather than terrestrial habits. Prof. Owen states that he has not found any of the remains of the extremities of the Cetiosaurus to agree exactly in shape with those belonging to the Polyptychodon; also that no specimen of a tooth agreeing in characters with the teeth of the Polyptychodon has been detected in secondary strata inferior to the greensand. Certain large conical teeth, found in the Malton oolite, may, Mr. Owen thinks, appertain to the Cetiosaurus, but he is of opinion that they more probably belong to the Steneosaurus.

In conclusion, it is stated that the vertebræ described in the paper prove the existence of a saurian genus distinct from the Megalosaurus, Steneosaurus, Poikilopleuron, Plesiosaurus, or any other large extinct reptile, remains of which have been discovered in the oolitic series; that the vertebræ, as well as the bones of the extremities, prove its marine habits; and that the surpassing bulk and strength of the Cetiosaurus were probably assigned to it with carnivorous habits, that it might keep in check the Crocodilians and Plesiosauri.

January 5, 1842.—A paper " On the Mouths of Ammonites, and on Fossils contained in laminated beds of the Oxford Clay, discovered in cutting the Great Western Railway, near Christian Malford in Wiltshire." By J. Chaning Pearce, Esq., F.G.S., was read.

Mr. Pearce commences by stating, that his attention was first directed to this part of the railway by the impression of a crushed Ammonite procured at Cheltenham in April 1841, but that he was prevented from examining the locality for three or four months.

The following section of the beds is given by Mr. Pearce :—

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| 1. Alluvial soil........................ | 2 feet. |
| 2. Gravel.............................. | 8 — |
| 3. Four or five bands of laminated clay, alternating with sandy clay, almost entirely composed of broken shells.... | 6 — |
| 4. Clay, containing *Gryphæa bilobata.* | |

The objects of the author are, first to draw attention to the organic bodies discovered in the laminated clay; and secondly, to describe the various forms which the mouth of the Ammonite assumes in different species and in different stages of growth in the same species.

The fossils obtained from the laminated clay are stated to be as follows :—1. A succulent plant. 2. Lignite, with oysters sometimes affixed to it. 3. Crustaceans, supposed to have inhabited the dead shell of the Ammonite*. The specimen described is stated to have a finely tuberculated and delicately thin covering; the tail to have the appearance of being divided into three portions, finely corrugated towards their edges; the body to have on each side internally five or more processes; and the head to be furnished with several short arms and two long ones jointed a little above the head and terminated in two claws, the longer being serrated on its inner edge. 4. Another allied crustacean is stated to have also an extremely thin and finely tuberculated covering; to be furnished with two long arms of similar shape, each terminated at its extremity by one claw, and two others projecting from about the centre, and passing off posteriorly are two fan-like processes of similar shape. 5. Trigonellites, two species. 6. One valve of a Pollicipes. 7. The remains of an animal considered to have been probably allied to a Sepia. 8. Shells of the genera Unio, Cyclas, Astarte, Avicula, Gervilla, Pinna, Nucula, Rostellaria, Turritella, Ammonites†, Belemnites, and an animal to which he has applied (since the paper was read) the name of Belemnotheutis. In describing the last fossil, he states that the lower part is conical, blunt at the apex, and chambered internally like the alveolus of a Belemnite, with an oval siphunculus near the edge of the chambers; that it has a brown thick shelly covering which gradually becomes thinner towards the superior part; that immediately above the chambers is an ink-bag resting on what resembles the upper part of a sepiostaire, and composed of a yellow substance finely striated transversely, being formed of laminæ of unequal density; that in some specimens, broken longitudinally through the middle, are exposed long, flat, narrow processes of a different structure; that immediately beneath the superior contraction are two long feather-like processes, and one or more which are short, indicating, the author thinks, probably the situation of the mouth. With reference to the first part of the paper, Mr. Pearce also notices an animal allied to Sepia or Loligo, one side being covered by a pen resembling that of the Loligo, and having immediately underneath it, at the junction of the middle with the lower third, an ink-bag resting on what resembles a sepiostaire. He mentions likewise ten or twelve species of fishes, but without giving names; also coprolites.

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* To this organic body Mr. Pearce has given since the paper was read the name of Ammonicolax.

† Since the paper was written Mr. Pearce has consulted Mr. Pratt's account in the Annals of Natural History for November 1841, of Oxford clay Ammonites, and ascertained that he possesses [*A. Lonsdalii, A. Brightii*], [*A. Gulielmi, A. Elizabetheæ*], *A. Comptoni*, and *A. Königii*. The fossils included between brackets the author considers to belong to one species.

2. Respecting the form of the mouth of the Ammonites and the changes at different periods of growth, Mr. Pearce states his belief, that the terminal lip or mouth has a different shape in the young shell of almost every species, but assumes in the old a straight outline, and that he has been aware of this circumstance several years. Of cases of young shells with differently shaped lips, he mentions *Ammonites Brongniarti* (Inf. oolite), *A. sublævis* (Oxf. clay), *A. obtusus* (Lias), *A. Kœnigii* (Kelloway Rock, the mature shell is stated to have a straight mouth), *A. Calloviensis* (Kelloway Rock, the lip of the old shell is stated to be slightly contracted and to terminate with gently undulating sides), *A. Walcottii* (Lias), and *A. Goodhalli*, furnished in the mature state with a single horn-like projection at the front of the mouth. In addition to these species he enumerates those noticed in the preceding part of the paper. Mr. Pearce is further of opinion that at different periods of the formation of the shell the lateral processes were absorbed and reproduced, and that therefore they are found in various stages of growth, but are invariably wanting in the mature shell. In some species in which the successive mouths were much contracted or expanded, the new shell the author says was continued without the absorption of the lip, leaving a highly projecting rib or a deep furrow*.

After a careful examination of upwards of twenty species in his collection, with perfect mouths of all ages and from different strata, not including the Oxford clay, Mr. Pearce has found the external chamber to vary considerably in extent, occupying in some specimens the whole of the last whorl, but in others less than one-third, and without reference to age or species; and he therefore suggests that the young animal of the Ammonite filled the whole of the outer chamber, extending also to the extreme points of the lateral processes in those species which were provided with them; and thereby not only received support but afforded protection to a portion of the shell extremely liable to injury. In old individuals he is of opinion that the animal when quiescent was entirely contained within the last chamber.

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* The author was not acquainted with M. Al. d'Orbigny's work, *Pal. Francaise*, when he wrote the paper, and was not aware of the views given in it respecting the mouth of the Ammonite.